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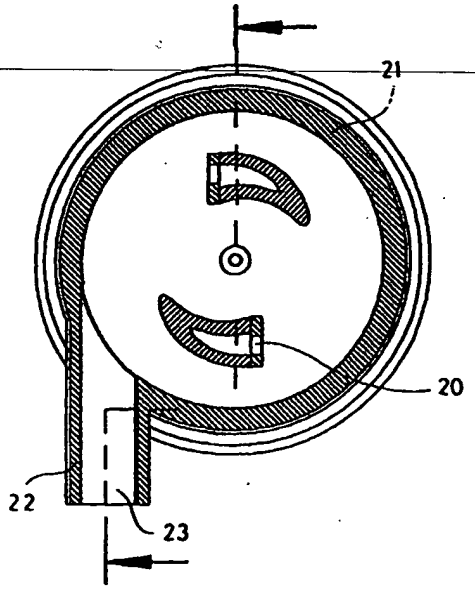
(54) Title: AN OUTLET OF A CENTRIFUGAL SEPARATOR HAVING A REACTION DRIVEN ROTOR



(57) Abstract

A centrifugal rotor (5) adapted to be reaction driven by means of pressurized liquid is rotatably arranged in a chamber (3) and surrounded by a housing (1) having a surrounding wall (21). For making it easier for liquid leaving the rotor (5) to flow out of the housing (1) without forming a pool therein said surrounding wall (21) has an outlet (23), which extends from the chamber (3) in a direction substantially opposite to the rotational direction of the rotor (5).

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An outlet of a centrifugal separator having a reaction driven rotor

The present invention relates to a centrifugal separator including a stationary housing, which form a chamber, and a rotor arranged in the chamber, the rotor being rotatable in a predetermined rotational direction around a rotational axis and adapted for its rotation to receive pressurized liquid and to discharge at least part of this liquid through at least one rotor outlet, situated at a distance from the rotational axis, in a direction such that the rotor is subjected to a reaction force in its circumferential direction as a consequence of outflowing liquid, said chamber being surrounded by a surrounding wall, which constitutes part of the housing and is provided with at least one outlet for liquid.

In a centrifugal separator of this kind, known for instance through WO 96/12549, it is desired that the stationary housing is only insignificantly larger than the rotor. Thereby, the air resistance to the rotor rotation within the housing can be made as small as possible. Furthermore, within a given space for the whole centrifugal separator the rotor can, thereby, be made as large as possible and, thus, get a capacity as large as possible.

A circumstance making it difficult to have the stationary housing only insignificantly larger than the rotor is that liquid having left the rotor requires a certain space within the housing around the rotor. Particularly if the rotor, as in a preferred embodiment of the present invention, is arranged with its rotational axis extending substantially horizontally, the housing can not be made too small. The reason for this is that part of said surrounding wall in this case forms a bottom of the chamber and that liquid, thereby, may collect and form a pool on this bottom, before it runs out through the outlet in the surrounding wall.

The present invention has for its object to avoid the above described difficulty and to make possible that the housing is made only insignificantly larger than the rotor.

This object can be obtained in that the outlet in the surrounding wall is formed in a way such that liquid is allowed to leave the chamber in a direction substantially opposite to the rotational direction of the rotor. An outlet formed in this way creates possibilities for the liquid to rapidly leave the chamber without forming a space-requiring pool therein, which may disturbe the rotation of the rotor. The invention builds on the circumstance that liquid leaving the rotor gets a component of movement in a direction opposite to the rotational direction of the rotor, not only seen in relation to the rotor but also seen in relation to the housing surrounding the rotor.

Thanks to the invention it becomes possible to arrange the centrifugal separator with the rotational axis of its rotor forming an angle with a vertical axis – even extending horizontally – without the housing around the rotor having to be made substantially larger than the rotor. It is particularly suitable to have the rotor outlet situated at one axial end of the rotor and the outlet in the surrounding wall situated at substantially the same axial level in the chamber as the rotor outlet.

For further acceleration of the liquid outflow from the chamber said surrounding wall preferably extends substantially circularly around the rotor and has, at least along part of its extension axially along the rotor, an increasing diameter in a direction towards the outlet in the surrounding wall.

The invention is described in the following with reference to the accompanying drawing, in which the figures 1 and 2 show a centrifugal sepa-

rator according to the invention in an axial section and in a section across the rotational axis of the rotor, respectively.

A centrifugal separator according to the invention may be used, for instance, connected with a self cleaning filter of the kind shown in WO 96/12549. Then, the centrifugal separator is adapted to be charged with pressurized oil containing solid particles, which have first been separated by means of said filter and then have been transported to the centrifugal separator by return rinsing of successive parts of the filter by means of cleaned oil still subjected to an overpressure. For a closer description of the self cleaning filter reference is made to WO 96/12549.

The centrifugal separator shown in the drawing is presumed to be connected with a filter of the kind shown in WO 96/12549. Differing however from the arrangement in WO 96/12549, the filter as well as the centrifugal separator in the arrangement here concerned are arranged with a horizontal rotational axis for their respective rotatable components. Thus, the centrifugal separator shown in figure 1 has a stationary housing 1, which through an annular flange 2 is connected with a housing (not shown) belonging to the aforementioned filter. The housing 1 delimits a chamber 3, and an end wall 4 at one end of the housing 1 constitutes a partition between the chamber 3 and the interior of said filter.

Within the chamber 3 there is arranged a rotor 5 rotatable around a horizontal rotational axis R. The rotor 5 is supported by a horizontal supporting shaft 6, which at one of its ends is journalled in a sleeve 7 connected with the housing 1 and at its other end is connected with a central member 8. The member 8, which in this case is constituted by a component of the self cleaning filter, is slowly rotatable around the rotational axis R of the rotor, has a channel 9 through which pressurized

oil should be transferred from the unshown filter to the shown centrifugal separator. The supporting shaft 6 of the rotor, which extends into the channel 9, has along part of its extension a central inlet channel 10 adapted to conduct oil from the channel 9 into the rotor 5.

The rotor 5 includes a central sleeve 11, which surrounds part of the supporting shaft 6 and through axially spaced slide bearings 12 and 13 is journalled thereon. Furthermore, the rotor 5 includes a casing 14 and an end wall 15, which are held connected with each other and with the central sleeve 11 by means of a ring 16. The casing 14 and the end wall 15 delimit a separation chamber 17 in the rotor. The supporting shaft 6 and the central sleeve 11 have holes 18 and 19, respectively, situated opposite to each other for conducting oil from the channel 10 into the separation chamber 17.

The end wall 15 of the rotor has two rotor outlets 20 for oil having been freed from particles in the separation chamber 17. The rotor outlets 20 are formed as nozzles and are situated at the same distance from but on diametrically opposite sides of the rotational axis R and are facing substantially in the circumferential direction of the rotor, as can be seen from figure 2.

The stationary housing 1 has a surrounding wall 21, which delimits the chamber 3 and concentrically surrounds the rotor 5. The surrounding wall 21 at a level lower than that of the rotor 5 has an outlet 22 forming an outlet channel 23. The outlet channel 23 extends from the chamber 3 tangentially out through the surrounding wall 21 in a direction substantially opposite to the rotational direction of the rotor.

In operation of the above described centrifugal separator pressurized liquid, e.g. oil, supplied to th rotor 5 through the inlet channel 10 will leave the rotor through the rotor outlets 20. The speed by which liquid leaves the rotor may be for instance 45 m/s. By the reaction force given to the rotor by the outflowing liquid the rotor may be caused to rotate and be kept in rotation by a speed such that the outlet nozzles may move at a speed of for instance 30 m/s.

This means that liquid leaving the rotor 5 may move relative to the housing 1 at a speed of for instance 15 m/s in a direction opposite to the rotational direction of the rotor. There will then come up a liquid flow in the chamber 3 along the surrounding wall 21 around the rotational axis of the rotor. For facilitating outflow of the liquid from the chamber 3 the outlet channel 23 in the outlet member 22, therefore, extends as previously described out of the chamber in a direction substantially opposite to the rotational direction of the rotor. Thereby, to the greatest possible degree it is avoided that liquid is collected in the chamber and forms a pool therein, which may impeed the rotor rotation.

The outlet channel 23 may have any suitable cross sectional form. It may for instance, at least at its opening in the chamber 3, have a larger extension along the rotational axis of the rotor than in the circumferential direction of the rotor. Possibly, said opening extends not only in an area axially at the same level as the rotor end wall 15, i.e. in the area of the rotor outlets 20, but also some distance along the casing 14 of the rotor.

As can be seen from figure 1, the surrounding wall 21 of the housing 1, which extends circularly around the rotor 5, has a form such that along its extension axially along the rotor it has an increasing diameter in a direction towards the outlet 23. Even this contributes to preventing formation of

a liquid pool at the bottom of the chamber 3 of the housing 1 in the area of the rotor 5.

Particles to be separated in the rotor separation chamber 17 are collected at the inside of the rotor casing 14. Intermittently, the centrifugal separator has to be taken out of operation and be disassembled for removal of such particles.

It should be observed that said supporting shaft 6 in the shown arrangement rotates relative to the housing 1 during operation of the centrifugal separator. Hereby is achieved that there is no risk, e.g. at a relatively slow rotation of the rotor 5, that the bearings 12 and 13 or the supporting shaft 6 would be unevenly worn as a consequence of the one-sided load of the rotor on the supporting shaft because the rotational axis of the rotor is horizontal. The rotation of the supporting shaft 6, thus, has a special meaning when it extends horizontally.

In the arrangement according to the figures 1 and 2 the outlet channel 23 of the housing 1 extends vertically and tangentially out of the chamber 3. To avoid that liquid would be left at the bottom of the chamber 3, when the centrifugal separator is taken out of operation, the housing 1 may be turned somewhat counter-clockwise from the position that can be seen in figure 2. Hereby, the part of the outlet channel 23 situated closest to the chamber 3 will be situated at the very lowermost part of the chamber 3, so that all liquid may run out thereof.

Claims

1. A centrifugal separator including a stationary housing (1), which forms a chamber (3), and a rotor (5) arranged in the chamber, the rotor being rotatable in a predetermined rotational direction around a rotational axis (R) and adapted for its rotation to receive pressurized liquid and to discharge at least part of this liquid through at least one rotor outlet (20), situated at a distance from the rotational axis (R), in a direction such that the rotor is subjected to a reaction force in its circumferential direction as a consequence of outflowing liquid, said chamber (3) being surrounded by a surrounding wall (21), which constitutes part of the housing and is provided with at least one outlet (22,23) for liquid, characterized in that said outlet (22,23) in the surrounding wall (21) is formed in a way such that liquid is allowed to leave the chamber (3) in a direction substantially opposite to said rotational direction of the rotor (5).

2. A centrifugal separator according to claim 1, in which the surrounding wall (21) has a substantially circular cross section and surrounds the rotor (5) substantially concentrically.

3. A centrifugal separator according to claim 1 or 2, in which the outlet (22,23) in the surrounding wall (21) is situated at substantially the same axial level in the chamber (3) as the rotor outlet (20).

4. A centrifugal separator according to claim 3, in which the rotor outlet (20) is situated at one axial end of the rotor (5).

5. A centrifugal separator according to any one of the preceding claims, in which the rotor (5) is arranged with its rotational axis (R) forming an angle with a vertical axis.

6. A centrifugal separator according to claim 5, in which the rotational axis (R) of the rotor (5) extends substantially horizontally.

7. A centrifugal separator according to claim 6, in which the outlet (22,23) in the surrounding wall (21) is situated at a level lower than that of the rotor (5).

8. A centrifugal separator according to any one of the preceding claims, in which said surrounding wall (21) extends substantially circularly around the rotor (5) and, along at least part of its extension axially along the rotor (5), has an increasing diameter in the direction towards the outlet (22,23) in the surrounding wall (21).

Fig.1

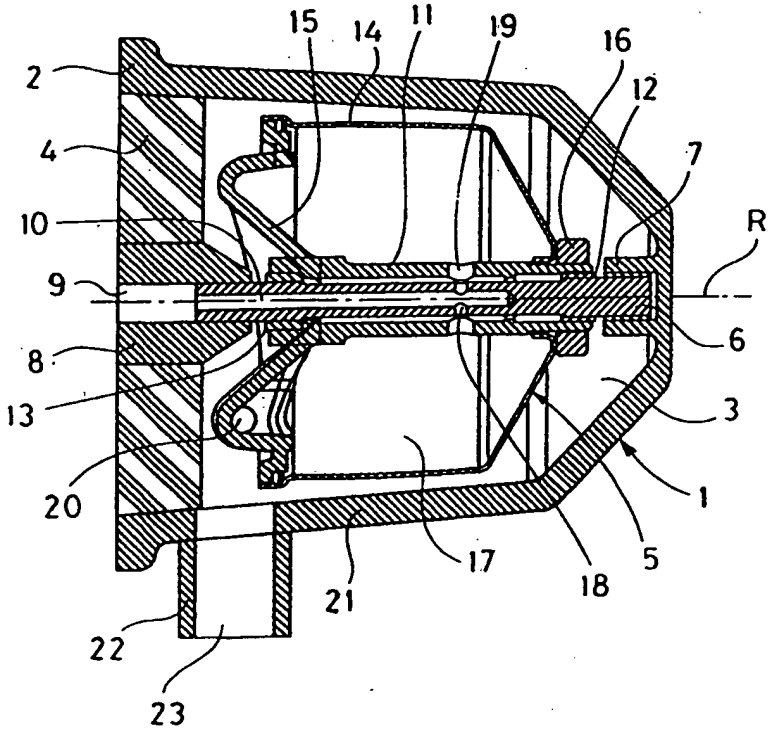
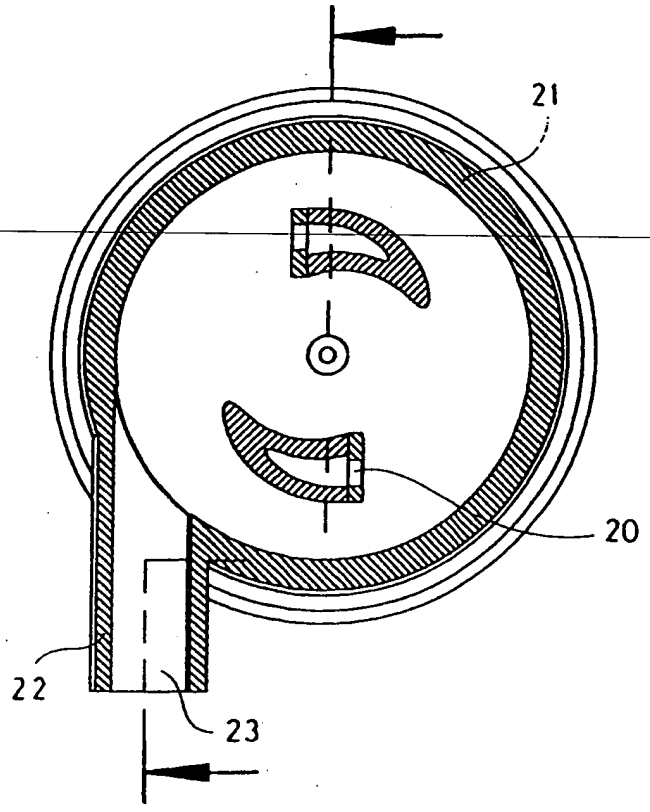


Fig.2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00168

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B04B 7/04, B04B 9/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2485390 A (I. LANGMUIR), 18 October 1949 (18.10.49), column 3, line 16 - line 19, figures 1, 2 --	1-8
A	WO 9612549 A1 (MOATTI FILTRATION S.A.), 2 May 1996 (02.05.96), page 4, line 29 - page 5, line 6 --	1,2

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2485390 A	18/10/49	NONE	
WO 9612549 A1	02/05/96	CA 2203007 A	02/05/96
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